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A New Species of *Upogebia* (Crustacea: Decapoda: Thalassinidea: Upogebiidae) from Okinawa Island, Ryukyu Islands

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Upogebia rupicola, a new species of upogebiid shrimp from Okinawa Island, Ryukyu Islands, lives in burrows made in siltstone substrates in the intertidal zone. It is similar to *U. carinicauda* (Stimpson, 1860), widely known from the Indo-West Pacific, but is distinguished from the latter by the structure and armament of the first pereopod and the armament of the lateral ridge of the anterior carapace.

Key Words: Crustacea, Decapoda, Upogebiidae, *Upogebia*, new species, Okinawa Island, Japan.

Introduction

The genus *Upogebia* is the most speciose among members of the family Upogebiidae, being represented by about 130 species in the world (Dworschak 2000). Most members are burrowers in intertidal and subtidal substrates (Le Loeuff and Intes 1974; Williams 1986, 1993; Itani 2004). Some inhabit dead coral skeletons or coral rocks (Williams 1993; personal observation), and still others are adapted for living in cavities of sponges (e.g., Barnard 1950; Poore and Griffin 1979). From Japanese waters, the following ten species of *Upogebia* are known (Itani 2004; Sakai *et al.* 2004): *U. major* (de Haan, 1841), *U. carinicauda* (Stimpson, 1860), *U. pugnax* de Man, 1905, *U. issaeffi* (Balss, 1913), *U. kyushuensis* Yokoya, 1933, *U. yokoyai* Makarov, 1938, *U. miyakei* Sakai, 1967, *U. imperfecta* Sakai, 1982, *U. snelliusi* Ngoc-Ho, 1989, and *U. trispinosa* Sakai and Mukai, 1991.

While examining material collected during a survey of intertidal infauna at Itoman, located in the southern part of Okinawa Island, Ryukyu Islands, 12 specimens of an undescribed species of *Upogebia* were collected from burrows excavated in siltstone substrates. The purpose of this paper is to describe a new species, *U. rupicola*, based on these specimens. The new species is similar to *U. carinicauda*, which is widely known from the Indo-West Pacific region.

Material and Methods

The holotype and some paratypes of the new species are deposited in the Natural History Museum and Institute, Chiba (CBM). The remaining paratypes are deposited in the National Science Museum, Tokyo (NSMT). Carapace length, abbreviated as CL, was measured from the tip of rostrum to the midpoint of the posterior margin of the carapace.

For comparison, the following specimens of *Upogebia carinicauda* were examined: Cape Panwa, Phuket, Thailand, intertidal, rock crevice, November 1995, coll. T. Komai, 2 males (CL 5.9, 8.5 mm), 1 ovigerous female (CL 7.2 mm), CBM-ZC 5577; Tatsugo Bay, northern Amami-Oshima Island, Ryukyu Islands, intertidal, 8 May 1997, coll. S. Kato, 5 males (CL 5.9–9.4 mm), 8 females (CL 8.6–9.6 mm), G. Itani's reference collection at Ehime University.

Taxonomic Account

Upogebia rupicola sp. nov.
(Figs 1-4)

Material examined. Holotype: Nashiro, Itoman, southern Okinawa Island, intertidal, burrow in siltstone, 18 August 2002, coll. Y. Kano *et al.*, male (CL 12.1 mm), CBM-ZC 8138. Paratypes: Same data as holotype, 3 males (CL 10.9–13.1 mm), 3 non-ovigerous females (CL 7.7–13.8 mm), 1 ovigerous female (CL 13.8 mm), CBM-ZC 8139; same locality, 19 August 2002, 2 non-ovigerous females (CL 14.2, 15.1 mm), 2 ovigerous females (CL 10.6, 11.0 mm), NSMT-Cr 16258.

Description. Rostrum (Fig. 1A, B) short, roundly triangular in dorsal view, straight in lateral view, tip exceeding eyestalks; dorsal pair of subapical spines strong, conical, followed on each side by 1 slightly curved spine of similar size; dorsal surface with dense mat of short setae; ventral surface rounded, unarmed. Anterior carapace (Fig. 1A, B) with posteriorly divergent lateral ridges each bearing row of 9–12 conical spines decreasing in size and sharpness toward posterior; anterior margin of lateral ridge not produced anteriorly; dorsal surface with distinct grooves running along lateral ridges and with numerous scattered conical spines or tubercles, these extending beyond midlength of anterior carapace, decreasing in size posteriorly, and obscured by dense mat of short setae; lateral surface weakly concave; anterolateral margin with 1 moderately small post-ocular spine. Posterior carapace (Fig. 1C) with shoulder lateral to cervical groove unarmed; thalassinidean line not reaching midlength of posterior carapace.

Pleuron of first abdominal somite poorly developed, pleura of second to fifth somites rather well developed and bearing thick fringe of long plumose setae on ventral margins of third and fourth somites, other pleura lacking dense setal fringe. Terga of second to fifth somites each with conspicuous, obliquely longitudinal groove on either side of midline; those of third and fourth somites with dense fringe of short plumose setae on posterior margin confluent with pleural fringe and row of similar setae along obliquely longitudinal grooves. Sixth somite (Fig. 1D) broader than long, lateral margins each with weak lobe at midlength; tergum with conspicuous, obliquely longitudinal grooves on either side of midline.

Telson (Fig. 1D) subrectangular, slightly broader than long; prominent and smooth transverse proximal ridge confluent with low lateral ridge at either side; dorsal surface with pair of shallow subcircular depressions proximal to transverse

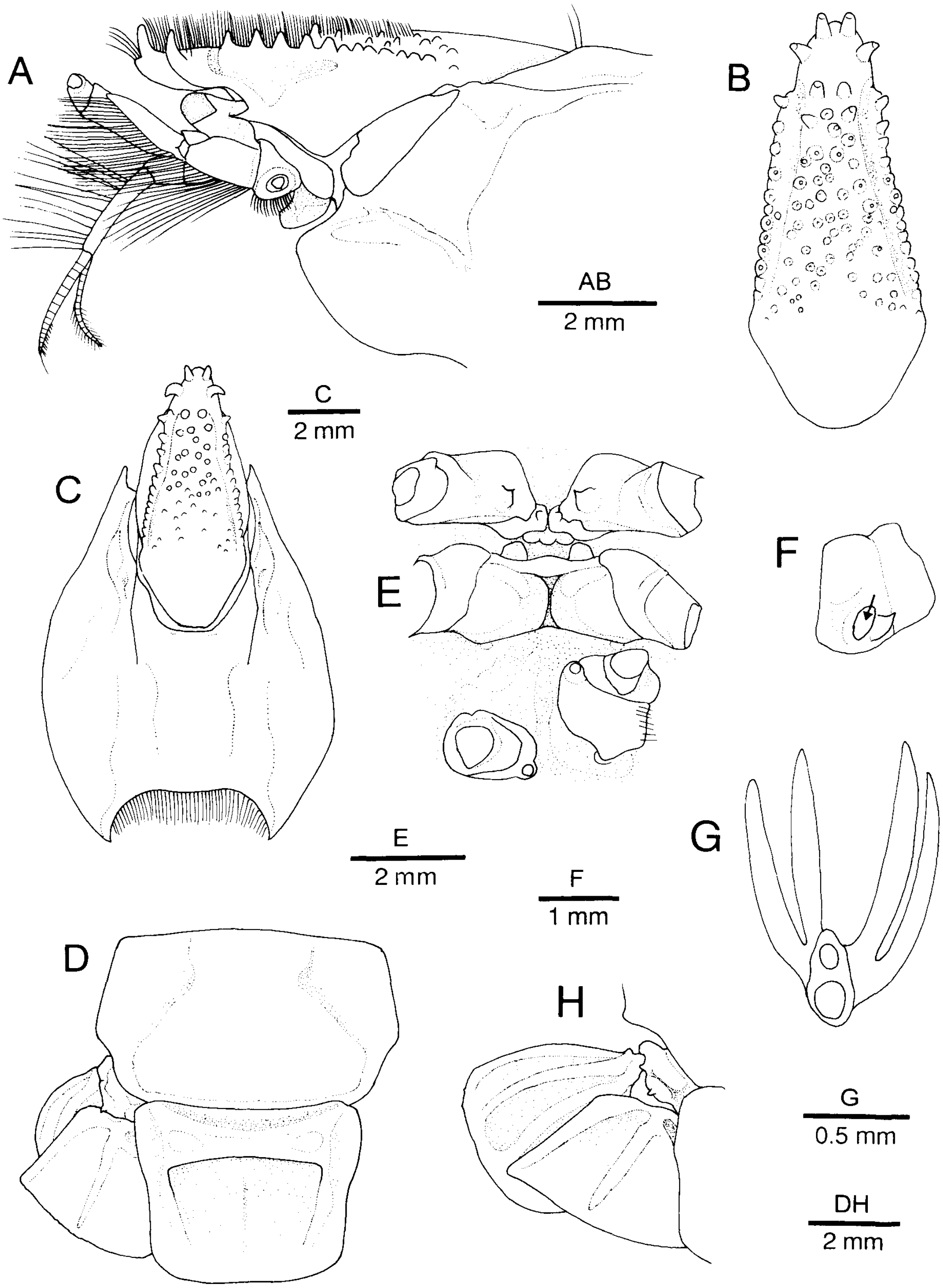

Fig. 1. *Upogebia rupicola* sp. nov., holotype male (CL 12.1 mm). A, Anterior part of carapace and cephalic appendages, lateral view; B, anterior carapace, dorsal view, mat of setae omitted; C, carapace, dorsal view, mat of setae on anterior carapace omitted; D, sixth abdominal somite, telson, and left uropod, dorsal view, setae omitted; E, coxae of third to fifth pereopods and posterior part of thoracic sternum, ventral view; F, coxa of left third pereopod, ventromesial view, with arrow indicating gonopore-like structure; G, gill lamella, dissected from arthrobranch on eighth thoracic somite; H, left uropod, dorsal view, setae omitted.

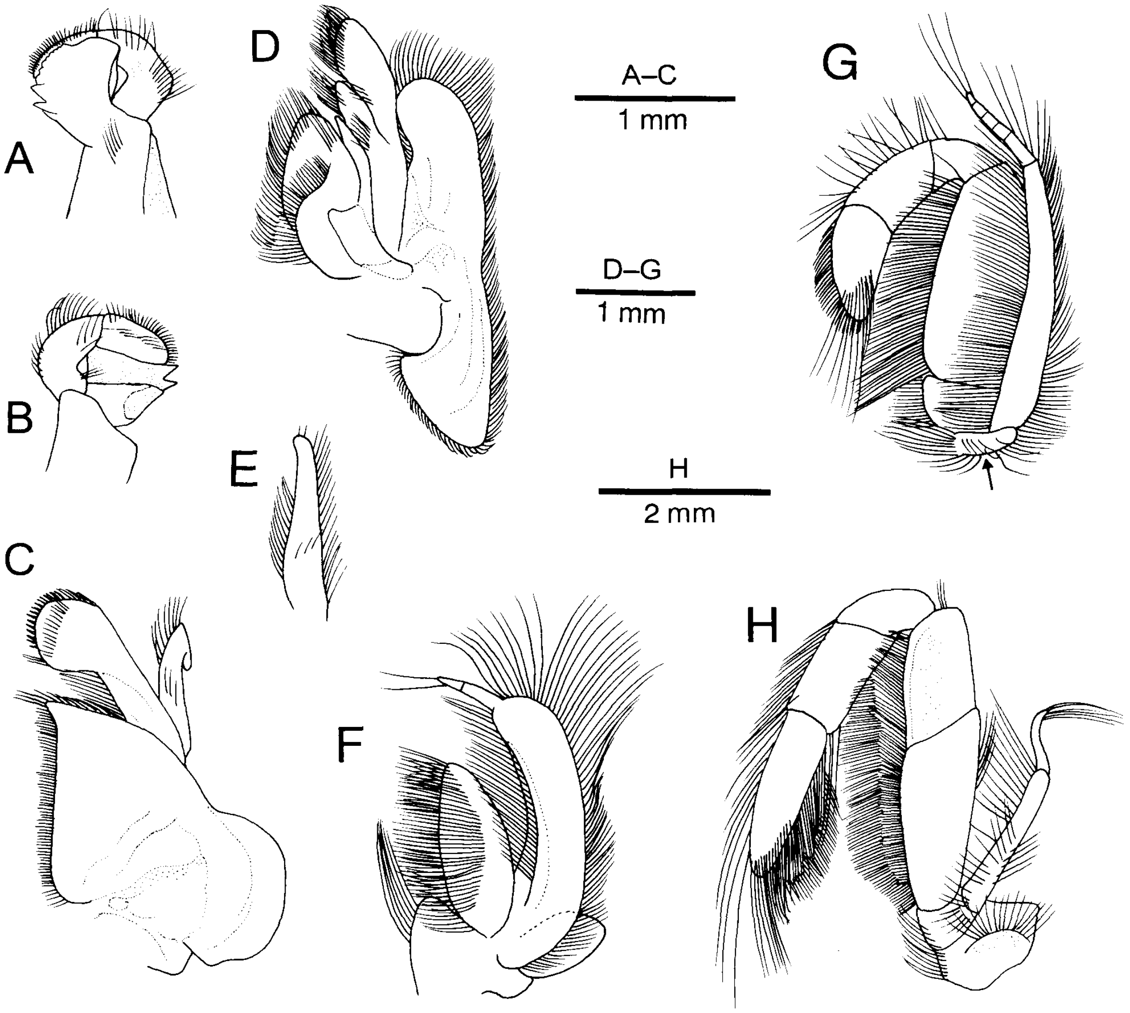

Fig. 2. *Upogebia rupicola* sp. nov., holotype male (CL 12.1 mm), left mouthparts. A, Mandible, external view; B, same, internal view; C, maxillule, external view; D, maxilla, external view; E, endopod of maxilla, internal view; F, first maxilliped, external view; G, second maxilliped, external view, with arrow indicating epipod; H, third maxilliped, lateral (external) view.

ridge, and with trace of median groove; posterior margin slightly convex, unarmed.

Eye-stalk (Fig. 1A) stout, slightly upturned, deepest at about midlength in lateral view, unarmed; cornea terminal, darkly pigmented, narrower than diameter of eye-stalk.

Antennular peduncle (Fig. 1A) reaching distal margin of antennal peduncle; proximal 2 segments together subequal in length to third (distal) segment.

Antennal peduncle (Fig. 1A) overreaching rostrum by 0.4–0.5 length of its third segment. First segment unarmed. Second segment with small subdistal ventral spine (not shown in Fig. 1A). Third segment unarmed. Scale subtriangular, terminating in acute or subacute point.

Mandible (Fig. 2A, B) with row of very small blunt teeth and 2 small acute teeth on cutting edge (mesial margin) of incisor process; palp composed of 2 articles. Maxillule (Fig. 2C) with recurved endopod; coxal endite large, with somewhat produced distomesial angle and well developed, broadly rounded proximolateral lobe; basial endite somewhat broadened distally, with double row of small corneous spines on mesial margin; Maxilla (Fig. 2D) with moderately broad scaphognathite; endopod (Fig. 2E) not visible in ventral view, slightly curved, tip rounded; coxal endite divided into greatly unequal lobes, proximal lobe large with sinuous line of setae on ventral surface, distal lobe narrow, tapering distally; basial endite also bilobed, proximal lobe distinctly broader than distal lobe of coxal endite. First maxilliped (Fig. 2F) with large, subovate epipod; exopod slightly expanded at distolateral angle, entire lateral margin fringed with row of long setae, with short flagellar portion composed of 2 articles; endopod not reaching base of exopodal flagellum. Second maxilliped (Fig. 2G) with small epipod; exopod slender, with multiarticulated flagellum; endopod pediform, composed of 6 segments (basis and ischium fused); merus broad. Third maxilliped (Fig. 2H) moderately stout, lacking epipod; exopod short, not reaching distal margin of ischium, bearing short flagellum.

First pereopod of males (Figs 3A, 4A, B) moderately stout for genus. Coxa unarmed. Ventral margin of ischium with 1 small tubercle. Merus with 1–4 very small tubercles or denticles on ventral margin (number usually bilaterally asymmetrical); dorsal margin convex in distal part, armed with slender subdistal spine. Carpus trigonal, with shallow longitudinal groove on lateral face; strong spine at ventrodistal angle preceded by smaller spine; dorsomesial margin unarmed or with row of tiny tubercles obscured by longitudinal tract of dense long setae; mesial face with dense tuft of long setae proximally, distomesial margin with large spine dorsally and smaller spine arising at middle. Palm 1.8–2.2 times as long as high, somewhat twisted; dorsal surface with row of 10–14 small spines or spinules mesially, dorsodistal margin with large spine mesially; dactylar condyle on lateral face large, prominent; lateral face with obliquely longitudinal line of setae confluent with ventral line of long setae and with scattered short setae; mesial face with row of low, small tubercles or protuberances each bearing tuft of long setae adjacent to dorsomesial row of spines and with several tufts of short setae along midline; 1 or 2 moderately large ventromesial spines arising from midlength of palm; proximal vertical ridge tuberculate, confined to ventral half. Fixed finger subequal to or slightly longer than dactylus, but more slender, 0.4–0.6 length of palm, and tapering to slender tip, with 4 or 5 rounded teeth on cutting edge. Dactylus terminating in calcareous claw, with dorsal (extensor) surface flat or slightly concave and naked, both dorsolateral and dorsomesial margins weakly ridged; lateral face with shallow longitudinal groove on midline, accompanied by line of long setae and with short oblique row of setal tufts ventral to midline proximally; mesial face (Fig. 4C) with shallow longitudinal groove accompanied by setal line adjacent to dorsomesial margin and median ridge composed of 9–12 blunt tubercles, ventromesial part concave, with sparse row of tufts of long setae; cutting edge with 4–6 low, blunt teeth.

Coxa to merus of female first pereopod generally similar to those of male first cheliped. Carpus (Fig. 4D) more elongate, middle spine on distomesial margin much smaller than dorsodistal mesial spine, occasionally absent. Palm (Fig. 4D, E) less robust, about 3.0 times as long as high, with ventral margin more concave; setation generally similar to that of males; 1–9 spines of dorsomesial row larger and more widely spaced than in males; proximal vertical ridge on mesial face smooth

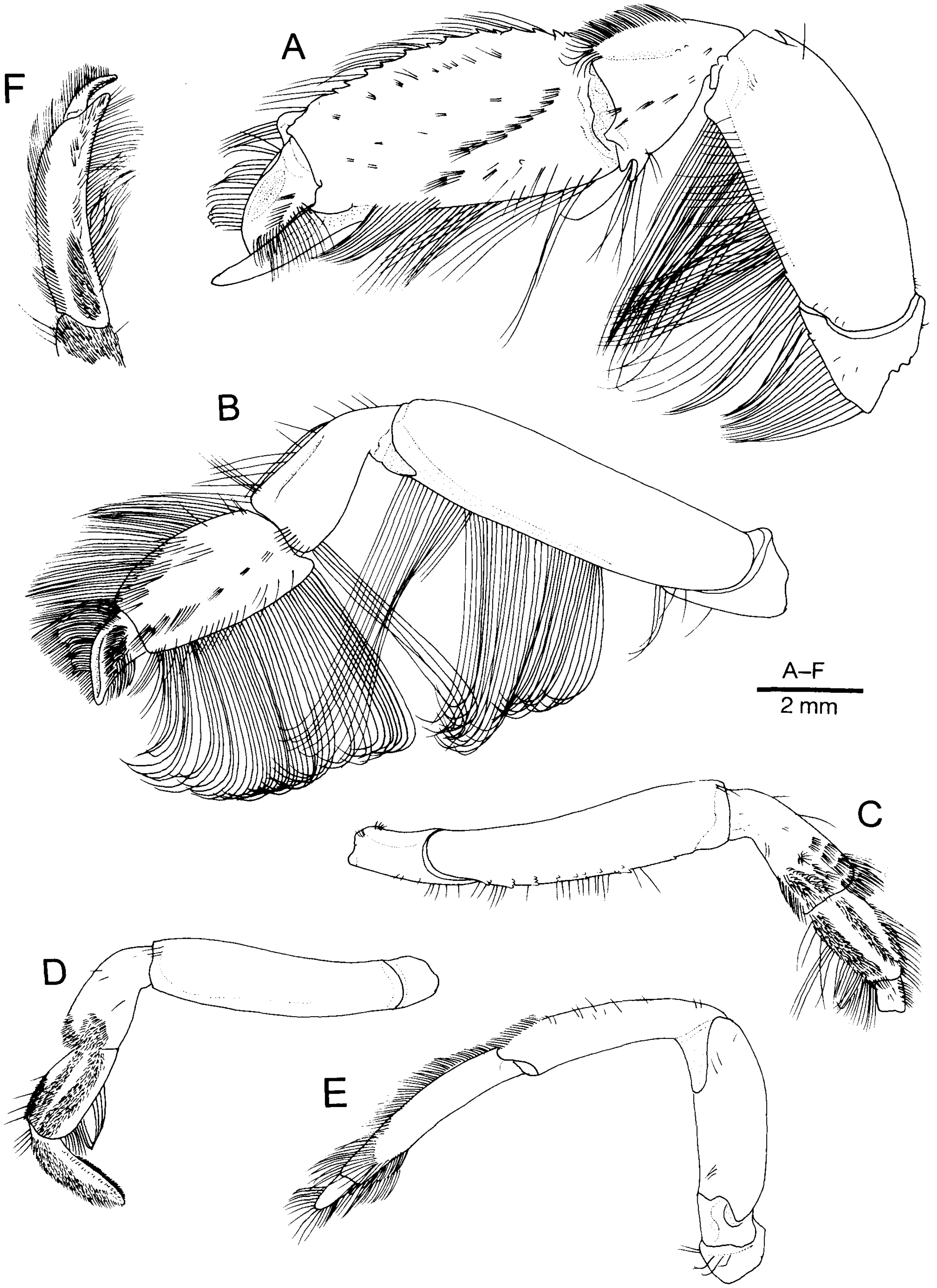

Fig. 3. *Upogebia rupicola* sp. nov., holotype male (CL 12.1 mm), pereopods. A, Left first pereopod, lateral view; B, left second pereopod, lateral view; C, right third pereopod, lateral view; D, left fourth pereopod, lateral view; E, left fifth pereopod, lateral view; F, same, propodus and dactylus, ventral view.

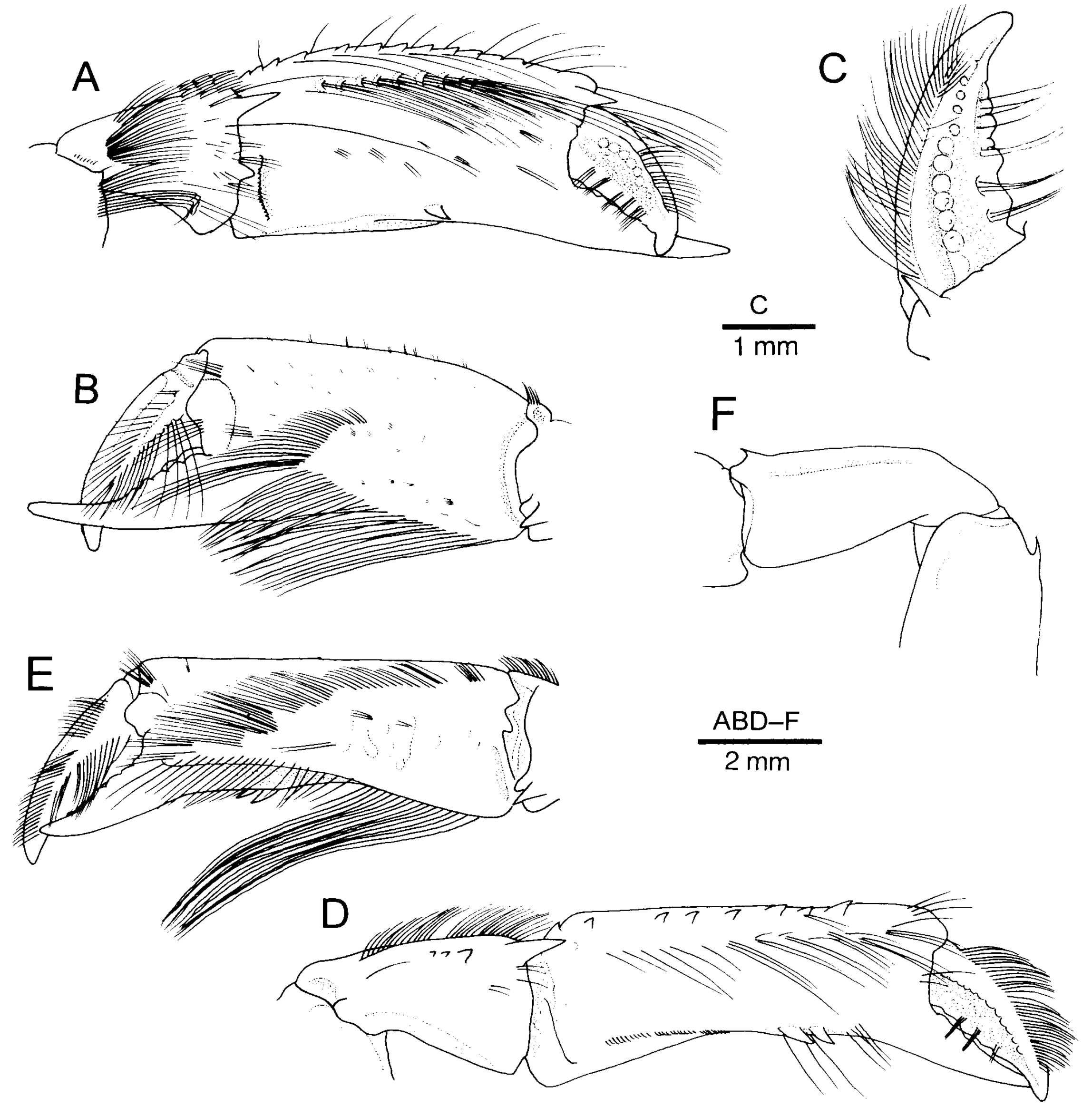

Fig. 4. *Upogebia rupicola* sp. nov. A–C, Holotype male (CL 12.1 mm); D–F, paratype ovigerous female (CL 13.8 mm; CBM-ZC 8139). A, D, Chela and carpus of left first pereopods, mesial view; B, E, chela of left first pereopods, lateral view; C, dactylus of left first pereopod, mesial view, F. distal part of merus and carpus of left second pereopod, lateral view, setae omitted.

or only faintly tuberculate; ventromesial margin with 1 or 2 large spines arising slightly distal to midlength of palm. Fixed finger and dactylus generally similar to those of males, mesial face of dactylus bearing longitudinal ridge composed of 10–13 small tubercles.

Second to fifth pereopods moderately long and slender; setation typical of genus. Second pereopod (Fig. 3B) reaching base of dactylus of first pereopod; coxa bearing tiny spine on posteroventral margin; ischium unarmed; merus usually with small subdistal spine on dorsal margin (Fig. 4F) (absent in holotype; see Fig. 3B), ventral margin unarmed; dorsal surface of carpus unarmed, or armed with small subdistal spine; lateral face of carpus with shallow longitudinal groove adjacent to dorsal margin; propodus unarmed, about 1.6 times as long as high, proximoventral margin weakly produced; dactylus triangular, with oblique dorsolateral surface bordered by thin corneous ridges extending to tip. Third pereopod (Fig. 3C) with coxa bearing small ventromesial spine in males (Fig. 1E); gonopore situated at top of short projection in females; males rarely with small, gonopore-like structure on mesial face of coxa (Fig. 1E); ischium unarmed; merus unarmed on dorsal margin, but ventral margin with row of small, occasionally multifid tubercles at least on proximal half; carpus unarmed; propodus oval, unarmed; dactylus slightly longer than propodus, somewhat twisted, ventral margin pectinate, with small, procurved corneous teeth. Fourth pereopod (Fig. 3D) with unarmed segments; dactylus subequal in length to propodus, somewhat twisted, ventral margin pectinate. Fifth pereopod (Fig. 3E, F) subchelate, segments unarmed; propodus subequal in length to carpus; dactylus longer than fixed finger, somewhat curved.

Arthrobranchs of type C (Fig. 1G; see Ngoc-Ho 1981), composed of deeply divided, narrow lamellae on either side of rachis.

Males lacking first pleopod; endopods of second to fifth pleopods oval. Females with uniramous first pleopod; endopods generally similar to those of males but more setose, particularly in spawning molt.

Uropod (Fig. 1H) not exceeding posterior margin of telson; protopod with tiny spine above base of endopod. Exopod with 2 distinct dorsal and 1 lateral carinae, lateral margin slightly convex; posterior margin with row of minute granules. Endopod with lateral and median carinae, anterolateral angle blunt; posterior margin slightly sinuous, smooth, posterolateral angle somewhat produced into rounded lobe.

Ovigerous females carrying numerous small, globular eggs of 0.5–0.6 mm in diameter.

Coloration in life. Not recorded.

Size. CL 10.9–13.1 mm in males, 10.6–13.8 mm in ovigerous females; maximal total length about 40.0 mm.

Variation. As is apparent from the above description, the palm of the first cheliped shows sexual dimorphism in shape and armament as in other congeneric species (e.g., Sakai 1982; Williams 1993; Komai *et al.* 1999). The palm of the first pereopod is armed with a dorsomesial row of 10–14 small spines or spinules in males and one to nine spines in females.

Distribution and habitat. So far known only from the type locality. Specimens were found to live in burrows constructed in rather hard substrates composed of siltstone in the intertidal zone. The structure of the burrows was not examined.

Etymology. Noun in apposition from the Latin *rupes* (rock) and *cola* (living), in reference to the habitat of the new species.

Remarks. *Upogebia rupicola* sp. nov. closely resembles *U. carinicauda*. Shared characters include: the rostrum being armed with two pairs of subterminal spines; the lateral ridge of the anterior carapace not being produced anteriorly; the anterolateral margin of the carapace being armed with a post-ocular spine; the telson being provided with a conspicuous transverse ridge subproximally; the first maxilliped being provided with an epipod; the meri of the first and second pereopods each bearing a dorsal subdistal spine; and the gills being composed of deeply divided lamellae (Ngoc-Ho 1989; personal observation). This set of characters distinguishes *U. rupicola* and *U. carinicauda* from their congeners. The new species can be distinguished from *U. carinicauda* by the fully chelate first pereopod. In *U. carinicauda*, the first pereopod is subchelate, with the fixed finger distinctly shorter than the dactylus. Furthermore, the anterior four or five spines on the lateral ridge of the anterior carapace are conical in *U. rupicola*, rather than being blunt and tubercle-like as they are in *U. carinicauda*. The palm of the first pereopod is armed with a dorsomesial row of distinct spines in *U. rupicola*, which is absent or represented by a row of small granules or tubercles in *U. carinicauda*.

Upogebia foresti Ngoc-Ho, 1989 is also very similar to *U. rupicola* and *U. carinicauda*. Dr N. Ngoc-Ho has informed me that *U. foresti* may be synonymous with *U. carinicauda* (pers. comm.); therefore, *U. foresti* is not considered in the present paper.

The discovery of this new species in an easily explored intertidal habitat suggests that the inventory of the infauna in Okinawan waters is still far from complete. Such intertidal habitats are easily affected by human activities, and further investigation of the infauna is urgently needed for accurate documentation of the local faunal diversity.

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